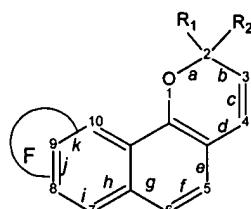


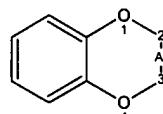
What is claimed is:

1. A photochromic naphthopyran having a central nucleus of the formula:



5

wherein F is a 1,4-benzodioxine ring having the following graphic formulae:

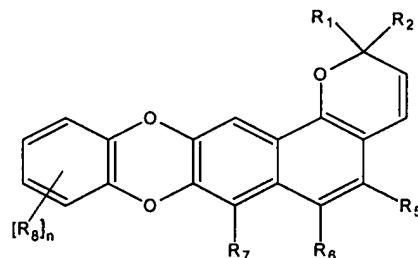


with its 2,3 positions fused to the i , j , or k side;

R_1 and R_2 are atoms or groups providing photochromic properties to the naphthopyran.

10

2. The photochromic naphthopyran of claim 1, characterized in that it has the following structure:



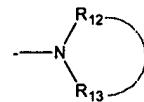
wherein,

R₁ and/or R₂, independently represent optionally substituted aryl or heteroaryl

15 groups the basic structure of which is selected from those of phenyl, naphthyl, biphenyl, pyridyl, furyl, benzofuryl, dibenzofuryl, N--(C₁-C₆)alkylcarbazole, thienyl, benzothienyl, dibenzothienyl, julolidinyl groups; R₁ and/or R₂ advantageously representing a para-substituted phenyl group, said substituents are selected preferably from alkoxy, dialkylamino, diarylamino, or R₁ and R₂ together form an adamantyl group or norbornyl group or anthracenylidene

group; either R₁ or R₂ is mono- or di-substituted phenyl which is substituted in the position para to the connection side with -phenyl, -(CH₂)_p-phenyl or -O-(CH₂)_p-phenyl substituted, wherein p is an integer from 1 to 6, and the ring of the substituent group forms part of a second photochromic pyran;

- 5 R₅ and R₆ are the same or different, and may represent independently
 a hydrogen,
 a linear or branched alkyl group that comprises 1 to 6 carbon atoms,
 a -C(R₁₄)₂X group, wherein X is hydroxy, alkoxy, benzyloxy, C₁-C₆
 acyloxy, an amine or amide group: -NH₂, -NHR₁₂, -N(R₁₂)₂, -CONH₂, --
10 CONHR₁₂, -CON(R₁₁)₂, R₁₄ is hydrogen, C₁-C₆ alkyl, phenyl or
 naphthyl with C₁-C₆ alkyl or C₁-C₆ alkoxy substituents,
 an optionally substituted phenyl or benzyl group,
 a -COR₁₅, or --COOR₁₅ group, R₁₅ representing a linear or branched alkyl
 group comprising 1 to 6 carbon atoms,
15 or alternatively, R₅ and R₆ may together form a 5- to 7-member optionally
 substituted carbocyclic or heterocyclic ring which can comprise at least
 one heteroatom selected from oxygen, sulfur, and nitrogen. The ring
 may be annelated with one aromatic group. Said substituents are selected
 from the group consisting of a C₁ to C₆ alkyl group which is linear or
 branched, a C₁ to C₆ alkoxy group which is linear or branched, and an
 amine group of formula
20



wherein R₁₂ and R₁₃, which are the same or different, independently
represent a hydrogen, a linear, branched, or cyclic alkyl group
comprising 1 to 6 carbon atoms, an aryl or heteroaryl group, or
representing, together with the nitrogen atom to which they are bound, a
25 5- to 7-membered ring which can comprise at least one other
 heteroatom selected from oxygen, sulfur and nitrogen, said nitrogen
 atom in the 5- to 7-membered ring being optionally substituted with an

R₁₀ group, which R₁₀ is a linear or branched alkyl group comprising 1 to 6 carbon atoms, a phenyl, a benzyl, or a naphthyl group.

R₇, and R₈ are independently

a hydrogen,

5 a linear or branched alkyl group which comprises 1 to 6 carbon atoms,

a cycloalkyl group comprising 3 to 7 carbon atoms,

a linear or branched alkoxy group comprising 1 to 6 carbon atoms,

a haloalkyl, halocycloalkyl, or haloalkoxy group where alkyl groups comprise C₁ – C₆ alkyl groups, C₁ – C₆ haloalkoxy groups above

10 respectively, which are substituted with at least one halogen atom,

notably selected from fluorine, chlorine and bromine,

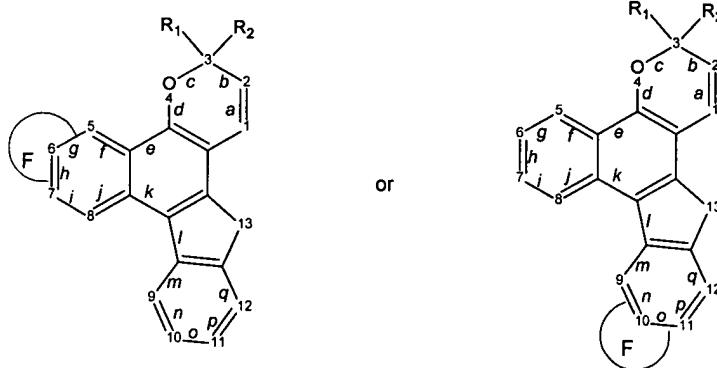
a linear or branched alkenyl or alkynyl group comprising 1-12 carbon

atoms, a linear or branched alkenoxy or alkynoxy group comprising 1-12

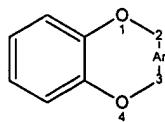
carbon atoms, and

15 n is an integer from 0 to 4.

3. A photochromic naphthopyran having a central nucleus of the formula



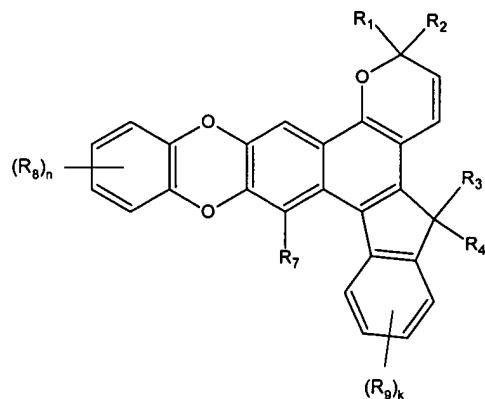
wherein F is a 1,4-benzodioxine ring having the following graphic formulae:



with its 2,3 positions fused to the *i, j, or k* side;

5 R₁ and R₂ are atoms or groups providing photochromic properties to the naphthopyran, and F, with its 2,3 positions, is fused to the *g, h, i, n, o, or p* side;

4. The photochromic naphthopyran of claim 3, characterized in that it has the
10 following structure



wherein,

R₁, R₂, R₇, and R₈ are as defined in Claim 2. R₉ independently represents groups as defined for R₈. n and k are integers from 0 to 2;

R₃ and R₄ are the same or different, and may represent independently

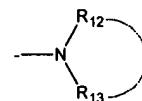
- 15 a hydrogen, a hydroxy, a halogen,
 a linear, branched, or cyclic alkyl group that comprises 1 to 6 carbon atoms,
 a -OR₂₀ group, wherein R₂₀ is (C1-C3)alkyl, phenyl(C1-C3)alkyl,
 mono(C1-C3)alkylphenyl(C1-C3)alkyl, mono(C1-C3)alkoxyphenyl(C1-
20 C3)alkyl, (C1-C3)alkoxy(C2-C4)alkyl, fluoro(C1-C3)alkyl, chloro(C1-C3)alkyl, or optionally substituted phenyl groups,

an optionally substituted aryl group, said substituents being mono, di-, or tri-, and selected from group R₂₀, and OR₂₀,

5 a -C(R₁₄)₂X group, wherein X is hydroxy, alkoxy, benzyloxy, C1-C6 acyloxy, an ester group: -COOR₁₁, an amine or amide group: -NH₂, -NHR₁₂, -N(R₁₂)₂, -CONH₂, --CONHR₁₂, -CON(R₁₂)₂, R₁₄ is hydrogen, C1-C6 alkyl, phenyl or naphthyl with C1-C6 alkyl or C1-C6 alkoxy substituents,

a polyether or polyurea residue,

10 or R₃ and R₄ together form a 5- to 7-member optionally substituted spirocyclic ring which can comprise at least one heteroatom selected from oxygen, sulfur, and nitrogen, and may be annelated with one or two benzene groups, the substituents on said 5- to 7-member ring being



15 selected from the group consisting of a C1 to C6 alkyl group which is linear or branched, a C1 to C6 alkoxy group which is linear or branched, and an amine group of formula

wherein R₁₂ and R₁₃ are as defined in claim 2

5. A photochromic article comprising a light permeable matrix having applied thereto or dispersed or diffused therein a photochromic amount of a photochromic naphthopyran according to claim 1.

20 6. A photochromic article comprising a light permeable matrix having applied thereto or dispersed or diffused therein a photochromic amount of a photochromic naphthopyran according to claim 2.

25 7. A photochromic article comprising a light permeable matrix having applied thereto or dispersed or diffused therein a photochromic amount of a photochromic naphthopyran according to claim 3.

8. A photochromic article comprising a light permeable matrix having applied thereto or dispersed or diffused therein a photochromic amount of a photochromic naphthopyran according to claim 4.

5

9. The photochromic naphthopyran of claim 1 wherein R₁ and R₂ are selected from the group consisting of hydrogen atoms, halogen atoms, and organic groups.

10

10. The photochromic naphthopyran of claim 1 wherein R₁ and R₂ are selected from the group consisting of hydrogen atoms and organic groups.

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11. The photochromic naphthopyran of claim 1 wherein R₁ and R₂ are selected from the group consisting of hydrogen atoms, aliphatic groups, aryl groups, and heterocyclic groups.

15

12. The photochromic naphthopyran of claim 1 wherein R₁ and R₂ are selected from the group consisting of a) hydrogen atoms, b) a linear or branched alkyl group of 1 to 12 carbon atoms, c) a cycloalkyl group of 3 to 12 carbon atoms, d) an aryl group of 6 to 24 ring carbon atoms, e) a heteroaryl group of 4 to 24 carbon atoms and at least one hetero ring atom selected from sulfur, oxygen and nitrogen; and f) wherein R₁ and R₂ together form a heterocyclic ring.

20

13. The photochromic naphthopyran of claim 9 wherein the heterocyclic ring formed from R₁ and R₂ is selected from the group consisting of an adamantyl, norbornyl, fluorenylidene, di(C₁ - C₆)alkylanthracenylidene and spiro(C₅ - C₆)cycloalkylanthracenylidene group.

25

14. A photochromic article comprising a light permeable matrix having applied thereto or dispersed or diffused therein a photochromic amount of a photochromic naphthopyran according to claim 9.

30

15. A photochromic article comprising a light permeable matrix having applied thereto or dispersed or diffused therein a photochromic amount of a photochromic naphthopyran according to claim 10.

5 16. A photochromic article comprising a light permeable matrix having applied thereto or dispersed or diffused therein a photochromic amount of a photochromic naphthopyran according to claim 11.

10 17. A photochromic article comprising a light permeable matrix having applied thereto or dispersed or diffused therein a photochromic amount of a photochromic naphthopyran according to claim 12.

15 18. A photochromic article comprising a light permeable matrix having applied thereto or dispersed or diffused therein a photochromic amount of a photochromic naphthopyran according to claim 13.